information on removal actions may be found in other EPA guidances (EPA 1990b, 1991d).

2.2.2 Interim RODs

Interim RODs may be appropriate where there is a moderate to high degree of uncertainty regarding attainment of ARARs or other protective cleanup levels. As mentioned before, an interim action may be used to minimize further contaminant migration and reduce the risk of exposure to contaminated ground water. Interim actions include containment of the leading edge of a plume to prevent further contamination of unaffected portions of an aquifer, removal of source material, remediation of ground-water hot spots, and in some cases, installation of physical barriers or caps to contain releases from source materials. Interim actions should be monitored carefully to collect detailed information regarding aquifer response to remediation, which should be used to augment and update previous site characterization efforts. This information then can be used at a later date to develop final remediation goals and cleanup levels that more accurately reflect the particular conditions of the site.

It is important to note that for interim actions, ARARs must be attained only if they are within the scope of that action. For example, where an interim action will manage or contain migration of an aqueous contaminant plume, MCLs and MCLGs would not be ARARs, since the objective of the action is containment, not cleanup (although requirements such as those related to discharge of the treated water still would be ARARs, since they address the disposition of treated waste).

Furthermore, a requirement that is an ARAR for an interim action may be waived under certain circumstances. An "interim action" ARAR waiver may be invoked where an interim action that does not attain an ARAR is part of, or will be followed by, a final action that does (NCP §300.430(f)(1)(ii)(C)). For example, where an interim action seeks to reduce contamination levels in a ground-water hot spot, MCLs/MCLGs may be ARARs since the action is cleaning up a portion of the contaminated ground water. If, however, this interim action is expected to be followed by a final, ARAR-compliant action that addresses the entire contaminated ground-water zone, an interim action ARAR waiver may be invoked.

2.2.3 Final RODs

Where site characterization is very thorough and there is a moderate to high degree of certainty that cleanup levels can be achieved, a final decision document should be developed that adopts those levels. Conversely, in cases where there is a high degree of certainty that cleanup levels cannot be achieved, a final ROD that invokes a TI ARAR waiver and establishes an alternative remedial strategy may be the most appropriate option.[5] Note that for ROD-stage waivers, site characterization generally should be sufficiently detailed to address the data and analysis requirements for TI determinations set forth in this guidance.

2.2.4 ROD Contingency Remedies and Contingency Language

Where a moderate degree of uncertainty exists regarding the ability to achieve cleanup levels, a final ARAR-compliant ROD generally still is appropriate. However, the ROD may include contingency language that addresses actions to be taken in the event the selected remedy is unable to achieve the required cleanup levels (EPA 1990a, 1991a). The contingency language may include requirements to enhance or augment the planned remediation system as well as an alternative remedial technology to be employed if modifications to the planned system fail to significantly improve its performance. Use of language in final remedy decision documents that addresses the uncertainty in achieving required cleanup levels also is appropriate in certain cases. **However, language that identifies a TI decision (e.g., an ARAR waiver) as a future contingency of the remedy should be avoided.** Such language is not necessary, as a TI evaluation may be performed (and a decision made) by EPA at any site regardless of whether such a contingency is provided in the decision document.

Note that in cases of existing RODs that already include a contingency for invoking a TI ARAR waiver, the conditions under which the ARAR may be waived should be consistent with, and as stringent as, those presented in this guidance or a future update.

Furthermore, the fact that such contingency language has been included in an existing ROD does not alter the need to enhance or augment a remedy to improve its ability to attain ARARs before concluding that a waiver can be granted. It also

5 At sites where a TI ARAR waiver is invoked in the ROD, preparation of the pre-referral negotiation package ("mini-lit" package) must include analysis of the model Consent Degree language to ensure that appropriate consideration of the waiver's impact is incorporated.

should be noted that remediation must be conducted for a sufficient period of time before its ability to restore contaminated ground water can be evaluated. This minimum time period will be determined by EPA on a site-specific basis.

2.3 Documenting Ground-Water Remedy Decisions under RCRA

The instruments used for implementing the RCRA Corrective Action program (permits and orders) also are amenable to a phased approach to remedy selection and facility remediation. The RCRA program can use permits or orders to compel both interim measures and final remedies.

2.3.1. Permits/Orders Addressing Stabilization

RCRA permits or orders can require the stabilization of releases from solid waste management units (SWMUs) at the facility. The Stabilization Initiative focuses on taking interim actions to prevent the further spread of existing contamination and reduce risks. Examples of measures used for stabilization include capping, excavation, and plume containment. Since the long-term or final cleanup of the facility is not the objective of stabilization (although stabilization should be consistent with the final remedy), TI decisions are not applicable at this early stage. Information gained during stabilization should be used to help determine the restoration potential of the facility and the objectives of the final remedy.

2.3.2. Permits/Orders Addressing Final Remedies

Where achieving ground-water cleanup standards is determined by EPA to be technically impracticable, the permit or order addressing final remedies should include practicable and protective alternative remedial measures. EPA's decision to make a TI determination will be based on clear and convincing information provided by the owner/operator. EPA generally will seek public comment on TI determinations prior to implementation. EPA's preliminary TI determinations and justification for these determinations should be documented in a Statement of Basis. As discussed above, uncertainty in the ability to restore an aquifer should be reduced through phased characterization and the use of interim remedial measures, where appropriate.

Permits and orders that address "final" remedies should specify the remediation cleanup levels selected by the implementing Agency. Such permits and orders, however, generally should not incorporate contingency TI language. The permit or order will need to be modified to document the TI determination and to specify, as appropriate, alternative cleanup levels and alternative remedial measures that have been determined to be technically practicable and protective of human health and the environment.

3.0 Remedial Strategy for DNAPL Sites

Many of the subsurface contaminants present at Superfund sites and RCRA facilities are organic compounds that are either lighter-than-water NAPLs (LNAPLs) or DNAPLs. As mentioned in Section 1.1, the presence of NAPL contamination, and in particular DNAPL contamination, may have a significant impact on site investigations and the ability to restore contaminated portions of the subsurface to required cleanup levels. Furthermore, DNAPL contamination may be a relatively widespread problem. A recent EPA study (EPA 1993a) concluded that up to 60 percent of National Priorities List (NPL) sites may have DNAPL contamination in the subsurface; a significant percentage of RCRA Corrective Action facilities also are thought to be affected by DNAPLs. As proven technologies for the removal of certain types of DNAPL contamination do not exist yet, DNAPL sites are more likely to require TI evaluations than sites with other types of contamination. Although this guidance pertains to TI evaluations at all site types, EPA believes the significance of the DNAPL contamination problem warrants the following brief discussion of DNAPL contamination and recommended site management strategies.

DNAPLs comprise a broad class of compounds, including creosote and coal tars, polychlorinated biphenyls (PCBs), certain pesticides, and chlorinated organic solvents such as trichloroethylene (TCE) and tetrachloroethylene (PCE). The term "DNAPL" refers only to liquids immiscible in, and denser than, water and **not** to chemicals that are dissolved in water that originally may have been derived from a DNAPL source. DNAPLs may occur as "free-phase" or "residual" contamination. **Free-phase** DNAPL is an immiscible liquid in the subsurface that is under positive pressure; that is, the DNAPL is capable of flowing into a well or migrating laterally or vertically through an aquifer. Where vertically migrating free-phase DNAPL encounters a rock or soil layer of relatively low permeability (e.g., clay or other fine-grained layer), a DNAPL accumulation or "pool" may form. **Residual** DNAPL is immiscible liquid held by capillary forces within the pores or fractures in soil or rock layers; residual DNAPL, therefore, generally is not capable of migrating or being displaced by normal ground-water flow. Both free-phase and residual DNAPL, however, can slowly dissolve in ground water and produce "plumes" of aqueous-phase contamination. DNAPLs also can produce subsurface vapors capable of migrating through the unsaturated zone and contaminating ground water (EPA 1992c). Figure 2 depicts the various types of contamination that may be encountered at a DNAPL site.

The three areas that should be delineated at a DNAPL site are the DNAPL entry location, the DNAPL zone, and the aqueous contaminant plume. The **entry locations** are those areas where DNAPL was released and likely is present in the subsurface. Entry locations include waste disposal lagoons, drum burial sites, or any other area where DNAPL was allowed to infiltrate into the subsurface. The **DNAPL zone** is defined by that portion of the subsurface containing free-phase or residual DNAPL. Thus, the DNAPL zone includes all portions of the subsurface where the immiscible-phase contamination has come to be located. The DNAPL zone may occur within both the saturated zone (below the water table) and the unsaturated zone (above the water table). The DNAPL zone also may contain vapor and aqueous-phase contamination derived from the DNAPL. The DNAPL zone may include areas at relatively great depths and lateral distances from the entry locations, depending on the subsurface geology and the volume of DNAPL released. The **aqueous contaminant plume** contains organic chemicals in the dissolved phase. The plume originates from the DNAPL zone and may extend hundreds or thousands of feet downgradient (in the direction of ground-water flow). Figure 3 illustrates the various components of a DNAPL site.

Since each DNAPL site component may require a different remediation strategy, it is important to characterize these components to the extent practicable. Thus, the properties and behavior of DNAPL contamination require consideration when planning and conducting both site investigation and remediation. The potential for DNAPL occurrence at the site should be evaluated as early as possible in the site investigation. Recent publications such as "Estimating Potential for DNAPL Occurrence at Superfund Sites" (EPA 1992c) and "DNAPL Site Evaluation" (Cohen and Mercer, 1993) provide detailed guidance on these topics. At sites where DNAPL disposal is known or suspected to have occurred, likely DNAPL entry locations should be identified from available historical waste-management information and subsurface chemistry data. This information can assist in the delineation of the DNAPL zone.

Characterization and delineation of the DNAPL zone is critical for remedy design and evaluation of the restoration potential of the site. At many sites, a subsurface investigation strategy that begins outside of the suspected DNAPL zone may be appropriate ("outside-in" strategy), in part to minimize the possibility of inadvertent mobilization of DNAPLs to

Figure 2. Types of Contamination and Contaminant Zones at DNAPL Sites (Cross-sectional view)

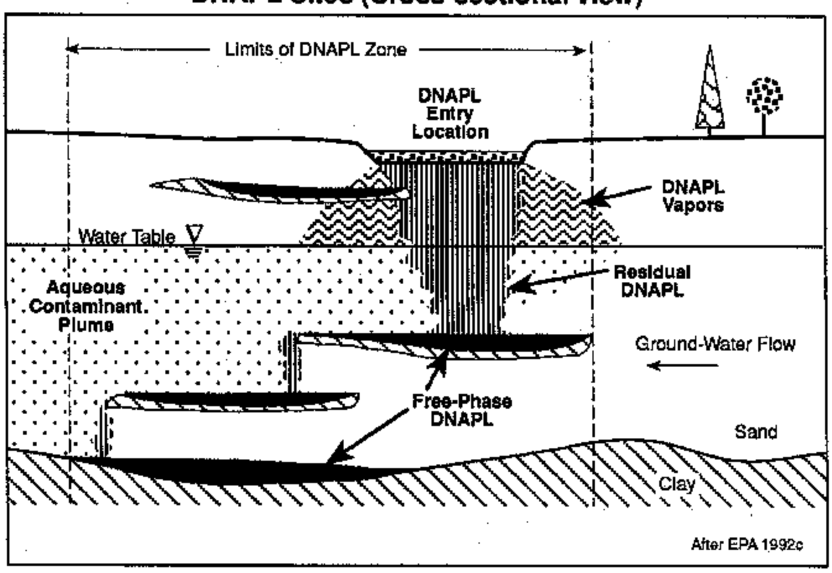
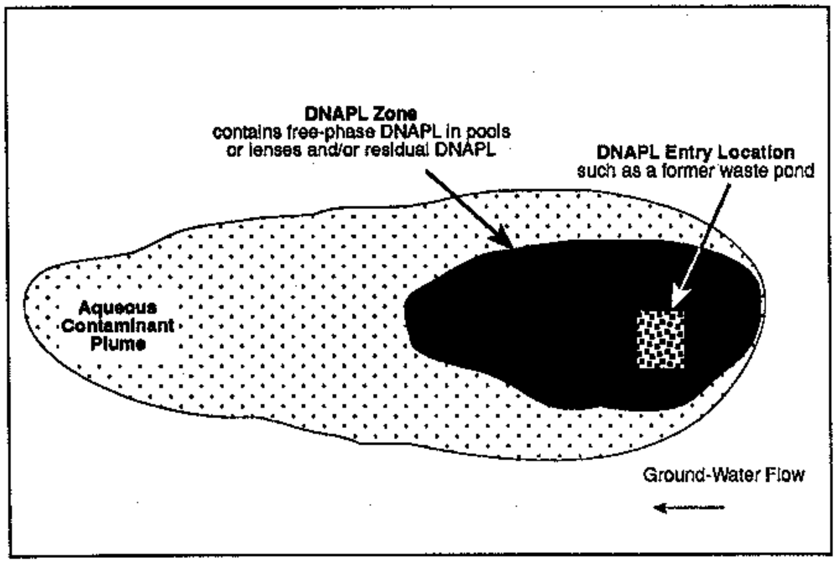


Figure 3. Components of DNAPL Sites



lower aquifers. Delineation of the extent of the DNAPL zone may be difficult at certain sites due to complex geology or waste disposal practices. In such cases, the extent of the DNAPL zone may need to be inferred from geologic information (e.g., thickness, extent, structure, and permeability of soil or rock units) or from interpretation of the aqueous concentration of contaminants derived from DNAPL sources. At some sites, however, geologic complexity and inadequate information on waste disposal may make the delineation of the DNAPL zone difficult.

A phased approach, as discussed in Section 2.1, is recommended for DNAPL sites; such an approach may facilitate identification of appropriate short- and long-term site remediation objectives. Note also that technical approaches appropriate for the DNAPL zone (e.g., free-phase DNAPL removal, vapor extraction, excavation, and slurry walls aided by limited pump-and-treat) may differ significantly from those appropriate for the aqueous contaminant plume (typically pump-and-treat).

Short-term remediation objectives generally should include prevention of exposure to contaminated ground water and containment of the aqueous contaminant plume. Where sufficient information is available, early removal of DNAPL sources also is recommended. Information gathered during these actions should be used to help characterize the site and identify practicable options for further remediation.

The long-term remediation objectives for a DNAPL zone should be to remove the free-phase, residual, and vapor phase DNAPL to the extent practicable and contain DNAPL sources that cannot be removed. EPA recognizes that it may be difficult to locate and remove all of the subsurface DNAPL within a DNAPL zone. Removal of DNAPL mass should be pursued wherever practicable and, in general, where significant reduction of current or future risk will result.[6] Where it is technically impracticable to remove subsurface DNAPLs, EPA expects to contain the DNAPL zone to minimize further release of contaminants to the surrounding ground water, wherever practicable.[7]

Where it is technically practicable to contain the long-term sources of contamination, such as the DNAPL zone, EPA expects to restore the aqueous contaminant plume outside the DNAPL zone to required cleanup levels. Effective containment of the DNAPL zone generally will be required to achieve this long-term objective because ground-water extraction remedies (e.g., pump-and-treat) or *in situ* treatment technologies are effective for plume restoration only where source areas have been contained or removed.

6 DNAPL mass removal also must satisfy the Superfund or RCRA Corrective Action remedy selection criteria, as appropriate.

7 As DNAPLs may be remobilized during drilling or ground-water pumping, caution should be exercised where such activities are proposed for DNAPL zone characterization, remediation, or containment.

Monitoring and assessing the performance of DNAPL zone containment and aquifer restoration systems, therefore, are critical to maintaining remedy protectiveness and evaluating the need for remedy enhancements or application of new technologies.

EPA recognizes, however, that there are technical limitations to ground-water remediation technologies unrelated to the presence of a DNAPL source zone. These limitations, which include contaminant-related factors (e.g., slow desorption of contaminants from aquifer materials) and hydrogeologic factors (e.g., heterogeneity of soil or rock properties), should be considered when evaluating the technical practicability of restoring the aqueous plume.

EPA encourages consideration of innovative technologies at DNAPL sites, particularly where containment of a DNAPL zone may require costly periodic maintenance (and perhaps replacement). Innovative technologies, therefore, should be considered where DNAPL zone containment could be enhanced or where such a technology could clean up the DNAPL zone.

4.0 TI Decisions and Supporting Information

4.1 Regulatory Framework for TI Decisions

The bases for TI decisions discussed in this guidance are provided in CERCLA and the NCP for the Superfund program and in the Proposed Subpart S rule for the RCRA program. While the processes the two programs use to establish cleanup levels differ (e.g., the ARAR concept is not used in RCRA), the primary considerations for determining the technical impracticability of achieving those levels are identical:

- **Engineering feasibility; and**
- **Reliability.**

A brief summary of the regulatory basis for establishing cleanup levels and making TI determinations at Superfund and RCRA sites is provided below.

4.1.1 Superfund

Remedial alternatives at Superfund sites must satisfy two "threshold" criteria specified in the NCP to be eligible for selection: 1) the remedy must be protective of human health and the environment; and 2) the remedy must meet (or provide the basis for waiving) the ARARs identified for the action.[8] There generally are several different types of ARARs associated with ground-water remedies at Superfund sites, such as requirements for discharge of treated water to surface water bodies or other receptors, limitations on reinjection of treated water into the subsurface, and cleanup levels for contaminants in the ground water. ARARs used to establish cleanup levels for current or potentially drinkable ground water typically are MCLs or non-zero MCLGs established under the Federal Safe Drinking Water Act, or in some cases, more stringent State requirements. For compounds for which there are no ARARs, cleanup levels generally are chosen to protect users or receptors from unacceptable cancer and non-cancer health risks or adverse environmental effects. Such levels generally are established to fall within the range of 10^{-4} to 10^{-6} lifetime cancer risk or below a hazard index of one for non-carcinogens, as appropriate.

ARARs may be waived by EPA for any of the six reasons specified by CERCLA and the NCP (Highlight 1), including **technical impracticability from an engineering perspective.** TI waivers generally will be applicable only for ARARs that are used to establish cleanup performance standards or levels, such as chemical-specific MCLs or State ground-water quality criteria.

Highlight 1.
CERCLA ARAR Waivers

The six ARAR waivers provided by CERCLA §121(d)(4) are:

1. Interim Action Waiver;
2. Equivalent Standard of Performance Waiver;
3. Greater Risk to Health and the Environment Waiver;
4. Technical Impracticability Waiver;
5. Inconsistent Application of State Standard Waiver; and
6. Fund Balancing Waiver.

8 NCP §300.430(f)(1)(i). For a detailed discussion of the Superfund remedy selection process, see also EPA 1988a and 1988b.

Use of the term "engineering perspective" implies that a TI determination should primarily focus on the technical capability of achieving the cleanup level, with cost playing a subordinate role. The NCP Preamble states that TI determinations should be based on:

> "...engineering feasibility and reliability, with cost generally not a major factor unless compliance would be inordinately costly."[9]

4.1.2 RCRA

The Proposed Subpart S rule specifies that the corrective action for contaminated ground water include attainment of "media cleanup standards," which generally are Federal or State MCLs, contaminant levels within the range of 10^{-4} to 10^{-6} lifetime cancer risk, or hazard index of less than one for non-carcinogens, as appropriate. The proposed rule also specifies three conditions under which attainment of media cleanup standards may not be required: 1) remediation of the release would provide no significant reduction in risks to actual or potential receptors; 2) the release does not occur in, or threaten, ground waters that are current or potential sources of drinking water; and 3) **remediation of the release to media cleanup standards is technically impracticable.**[10]

Further clarification of TI determinations is provided in the preamble to the proposed rule. The determination involves a consideration of the "**engineering feasibility and reliability**" of attaining media cleanup standards, as well as situations where remediation may be "technically possible," but the "scale of the operations required might be of such a **magnitude and complexity** that the alternative would be impracticable" (emphasis added).[11]

The basis for a RCRA Subpart S TI decision (engineering feasibility, reliability, and the magnitude and complexity of the action) therefore is consistent with that provided for the Superfund program in the NCP. In the context of remedy selection, both programs consider the notion of technical feasibility along with reliability and economic considerations; however, **the role of cost (or scale) of the action is subordinate to the goal of remedy protectiveness.**

4.2 Timing of TI Decisions

TI decisions may be made either when a final site decision document is being developed (e.g., RCRA Statement of Basis and Response to Comments or Superfund ROD) or after the remedy has been implemented and monitored for a period of time. EPA believes that, in many cases, TI decisions should be made only after interim or full-scale aquifer remediation systems are implemented because often it is difficult to predict the effectiveness of remedies based on limited site characterization data alone. However, in some cases, TI decisions may be made prior to remedy implementation. These pre-implementation or "front-end" TI decisions must be supported adequately by detailed site characterization and data analysis. Front-end TI evaluations should focus on those data and analyses that define the most critical limitations to ground-water restoration.

Data and analysis requirements for front-end decisions should be considered carefully. Generally, information regarding the nature and extent of contamination sources is more critical to assessing restoration potential than are other types of characterization data. This often is the case, as currently available technologies generally are more effective for remediating and restoring contaminated aquifers affected only by dissolved, or aqueous, contamination. However, certain types of source contamination are resistant to extraction by these technologies and can continue to dissolve slowly into ground water for indefinite periods of time. Examples of this type of source constraint include certain occurrences of NAPLs, such as where the quantity, distribution, or properties of the NAPL render its removal from, or destruction within, the subsurface infeasible or inordinately costly (See Section 3.0).

Geologic constraints, such as aquifer heterogeneity (e.g., interlayering of coarse and fine-grained strata), also may critically limit the ability to restore an aquifer. However, it generally is more difficult to accurately determine the impact of such constraints prior to implementation and monitoring of partial or full-scale aquifer remediation efforts. Some geologic constraints, however, may be defined sufficiently during site characterization so that their impacts on restoration potential are known with a relatively high degree of certainty. An example of this type of constraint includes complex fracturing of bedrock aquifers, which makes recovery of contaminated ground water or DNAPLs extremely difficult.

It should be noted, however, that the presence of known remediation constraints, such as DNAPL,

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9 See NCP Preamble, 55 FR 8748, March 8, 1990.

10 Technical impracticability is discussed in Sections 264.525(d)(2) and 264.531 of the Proposed Subpart S rule.

11 Proposed Subpart S; 55 FR 30830, July 27, 1990.

fractured bedrock, or other condition, are not by themselves sufficient to justify a TI determination. Adequate site characterization data must be presented to demonstrate, not only that the constraint exists, but that the effect of the constraint on contaminant distribution and recovery potential poses a critical limitation to the effectiveness of available technologies.

4.3 TI Evaluation Components[12]

Determinations of technical impracticability will be made by EPA based on site-specific characterization and, where appropriate, remedy performance data. These data should be collected, analyzed, and presented so that the engineering feasibility and reliability of ground-water restoration are fully addressed in a concise and logical manner.

The TI evaluation may be prepared by the owner/operator of a RCRA facility, by a PRP at an enforcement-lead Superfund site, or by EPA or the State at Fund- or State-lead sites, as appropriate. **The evaluation generally should include the following components, based on site-specific information and analyses:**

1. Specific ARARs or media cleanup standards for which TI determinations are sought (See Section 4.4.1).

2. Spatial area over which the TI decision will apply (See Section 4.4.2).

3. Conceptual model that describes site geology, hydrology, ground-water contamination sources, transport, and fate (See Section 4.4.3).

4. An evaluation of the restoration potential of the site, including data and analyses that support any assertion that attainment of ARARs or media cleanup standards is technically impracticable from an engineering perspective (See Section 4.4.4). At a minimum, this generally should include:

   a. A demonstration that contamination sources have been identified and have been, or will be, removed and contained to the extent practicable;
   b. An analysis of the performance of any ongoing or completed remedial actions;
   c. Predictive analyses of the timeframes to attain required cleanup levels using available technologies; and
   d. A demonstration that no other remedial technologies (conventional or innovative) could reliably, logically, or feasibly attain the cleanup levels at the site within a reasonable timeframe.

5. Estimates of the cost of the existing or proposed remedy options, including construction, operation, and maintenance costs (See Section 4.4.5).

6. Any additional information or analyses that EPA deems necessary for the TI evaluation.

The data and analyses needed to address each of these components of a TI evaluation should be determined on a site-specific basis. Where outside parties are preparing the TI evaluation, its contents generally should be identified and discussed prior to submittal of the evaluation to EPA. Early agreement between EPA and PRPs or owner/operators on the type and quantity of data and analyses required for TI decisions will promote efficient review of TI evaluations.

References to other documents in the administrative record, such as the RI/FS and RFI, likely will be necessary to produce a concise evaluation; however, these references should be as explicit as possible (e.g., cite specific page or table numbers). Technical discussions and conclusions should be supported by data compilations, statistical analyses, or other types of data reduction included in the evaluation.

4.4 Supporting Information for TI Evaluations

Most, if not all, of the information needed to evaluate TI could be obtained during a thorough site investigation and, where appropriate, remedy performance monitoring efforts. At some sites, however, additional analysis of existing data or new information may be required before EPA can determine accurately the technical practicability of the restoration goals. Not all of the data or analyses outlined in this guidance will be required at all sites; specific information needs will depend on site conditions and any ongoing remediation efforts.

12 For this guidance a "TI evaluation" comprises the data and analyses necessary to make a TI determination. The TI evaluation may be performed by PRPs at enforcement-lead Superfund sites, or by State or other Federal agencies, where appropriate. Similarly, owner/operators at RCRA facilities may perform TI evaluations. However, the actual TI "determination," or "decision," will be made by EPA (or other lead agency, as appropriate).

The data and analyses identified and discussed below address the TI evaluation components provided in Section 4.3.

4.4.1. Specific ARARs or Media Cleanup Standards

The TI evaluation should identify the specific ARARs or media cleanup standards (i.e., the specific contaminants) for which the determination is sought. Such contaminants generally should include only those for which attainment of the required cleanup levels is technically impracticable. Factors EPA will consider when evaluating contaminants that may be included in the TI decision include: 1) the technical feasibility of restoring some of the contaminants present in the ground water; and 2) the potential advantages of attaining cleanup levels for some of the contaminants.

For example, consider a Superfund site with a DNAPL contamination problem (e.g., TCE), including a widespread subsurface DNAPL source area for which containment or restoration are technically impracticable. The aqueous plume also contains inorganic contamination (e.g., chromium) from on-site sources. Although it would be feasible to reduce chromium concentrations to the required cleanup level within a reasonable timeframe, TCE concentrations would remain above cleanup levels much longer due to the continued presence of the DNAPL or slow desorption of TCE from aquifer materials. However, in such cases, EPA may choose to limit the TI ARAR waiver to TCE alone, while requiring cleanup of the chromium.[13]

Two situations would favor use of this approach. The first would be where attaining chromium cleanup levels in the ground water will make future *ex situ* treatment of the (TCE-contaminated) ground water less complex and less expensive. This may be advantageous where a community wishes to extract the TCE-contaminated water, perform *ex situ* treatment, and put the treated water to beneficial use. A related consideration is whether removal of the chromium will facilitate future subsurface remediation using a newly developed technology. The second situation favoring this approach is where one of the contaminants (e.g., TCE) is being naturally biodegraded and the other (e.g., chromium) is not. Therefore, cleanup of the chromium may result in more rapid attainment of the long-term cleanup goals at the site.

Where the balance of conditions at such a site do not indicate that it is practicable to attain the cleanup levels for only some of the contaminants present, EPA may conclude that cleanup levels for the remaining contaminants need not be attained, depending on the circumstances of the site. As discussed further in Section 5.0, however, this decision does not preclude EPA from selecting (or continuing operation of) a remedy that includes active measures (e.g., pump-and-treat) along with measures to prevent exposure (e.g., institutional controls) needed to address site risks.

4.4.2 Spatial Extent of TI Decisions

The TI evaluation should specify the horizontal and vertical extent of the area for which the TI determination is sought. Where EPA determines that ground-water restoration is technically impracticable, the area over which the decision applies (the "TI zone") generally will include all portions of the contaminated ground water that do not meet the required cleanup levels (contaminated ground-water zone), unless the TI zone is otherwise defined by EPA.

In certain cases, EPA may restrict the extent of the TI zone to a portion or subarea within the contaminated ground-water zone. For example, consider a DNAPL site where it is technically impracticable to remove the residual DNAPLs from the subsurface but it is feasible and practicable to: 1) limit further migration of contaminated ground-water using a containment system; and 2) restore that portion of the aqueous plume outside of the containment area. The TI zone in this case should be restricted to that portion of the site that lies within the containment area. Outside of the TI zone, ARARs or media cleanup standards still would apply. The potential to spatially restrict the TI zone, therefore, will depend on the ability to delineate and contain non-removable subsurface contamination sources and restore those portions of the aqueous plume outside of the containment area. The spatial extent of the TI zone should be limited to as small an area as possible, given the circumstances of the site.

A TI zone should be delineated spatially, both in area and depth. Depth of a TI zone may be defined in absolute terms (e.g., feet above mean sea level) or in relative terms (e.g., with respect to various aquifers within multi-aquifer systems), as appropriate. Where

13 The extracted ground water would likely need to be treated for both TCE and chromium to satisfy treatment and waste disposal ARARs.